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Historical Analysis of Costs, Risks, and Uncertainties: Moving From a Proprietary to an Open Architected Systems, Open Business Acquisitions Management Approach

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14. ABSTRACT
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Preface & Acknowledgements

Welcome to our Ninth Annual Acquisition Research Symposium! This event is the highlight of the year for the Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) because it showcases the findings of recently completed research projects—and that research activity has been prolific! Since the ARP's founding in 2003, over 800 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at www.acquisitionresearch.net, at a rate of roughly 140 reports per year. This activity has engaged researchers at over 60 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a "broker" to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and hope this symposium will spark even more participation.

We encourage you to be active participants at the symposium. Indeed, active participation has been the hallmark of previous symposia. We purposely limit attendance to 350 people to encourage just that. In addition, this forum is unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. Seldom will you get the opportunity to interact with so many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. In the words of one senior government official, "I would not miss this symposium for the world as it is the best forum I've found for catching up on acquisition issues and learning from the great presenters."

We expect affordability to be a major focus at this year's event. It is a central tenet of the DoD's Better Buying Power initiatives, and budget projections indicate it will continue to be important as the nation works its way out of the recession. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you're a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:

- Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)
- Director, Acquisition Career Management, ASN (RD&A)
- Program Executive Officer, SHIPS
- Commander, Naval Sea Systems Command
- Program Executive Officer, Integrated Warfare Systems
- Army Contracting Command, U.S. Army Materiel Command

- Office of the Assistant Secretary of the Air Force (Acquisition)
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- Deputy Assistant Secretary of the Navy, Acquisition & Procurement
- Director of Open Architecture, DASN (RDT&E)
- Program Executive Officer, Littoral Combat Ships

We also thank the Naval Postgraduate School Foundation and acknowledge its generous contributions in support of this symposium.

James B. Greene Jr.
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD
Associate Professor

Panel 17. Enabling an Open Architecture Environment

Thursday, May 17, 2012	
11:15 a.m. – 12:45 p.m.	**Chair: RADM James D. Syring,** USN, Program Executive Officer for Integrated Warfare Systems ***Competition and the DoD Marketplace*** Nickolas H. Guertin and Brian Womble *Deputy Assistant Secretary of the Navy for Research, Development, Test, and Evaluation* ***Historical Analysis of Costs, Risks, and Uncertainties: Moving From a Proprietary to an Open Architected Systems, Open Business Acquisitions Management Approach*** Tom Housel, Scott Cole, and Russel Wolff *Naval Postgraduate School* ***Market Forces and the Defense Acquisition Marketplace*** William Schmidt, *ANGLE Inc.*

James D. Syring—Rear Admiral Syring graduated from the United States Naval Academy in 1985 with a Bachelor of Science degree in marine engineering and was commissioned as an engineering duty officer. He completed his Master of Science degree in mechanical engineering from the Naval Postgraduate School in 1992. Syring is also a graduate of the Defense Systems Management College and a member of the Acquisition Professional Community.

Syring received his surface warfare officer qualification on board the USS *Downes* (FF 1070) where he served as auxiliaries and electrical officer and subsequently as electronics material officer. His engineering duty officer tours include ship superintendent for the USS *Port Royal* (CG 73) and Aegis test officer for new construction DDG 51 class ships on the staff of the supervisor of shipbuilding, Pascagoula, 1992–1996; combat systems, test and trials officer in the DDG 51 Aegis Shipbuilding Program Office (PMS 400D), 1996–1999; and combat systems baseline manager at the Aegis Technical Division, responsible for new construction Aegis baseline computer program development, 1999–2001. Syring served as director for surface combatants, Office of the Assistant Secretary of the Navy (Research, Development, and Acquisition), where he advised the secretary on all acquisition matters related to CG 47, DDG 51, DDG 1000, and LCS class ships from 2001 until 2003. His next assignment was as the technical director for the DDG 1000 Shipbuilding Program, serving in that capacity until 2005.

Most recently, Syring served as program manager for the U.S. Navy's DDG 1000 Program (2005–2010). As program manager, he was responsible for total ship systems engineering and acquisition of DDG 1000 and associated technologies, including integrated power systems, dual band radar, and the advanced gun system. Syring currently serves as the program executive officer for Integrated Warfare Systems (PEO IWS).

Syring's personal awards include the Legion of Merit (two awards), the Meritorious Service Medal (four awards), Navy Commendation Medal, and Navy Achievement Medal.

Historical Analysis of Costs, Risks, and Uncertainties: Moving From a Proprietary to an Open Architected Systems, Open Business Acquisitions Management Approach

Tom Housel—Housel is a professor of Information Sciences at the Naval Postgraduate School. Professor Housel specializes in valuing intellectual capital, knowledge management, telecommunications, information technology, value-based business process re-engineering, and knowledge value measurement in profit and non-profit organizations. His current research focuses on the use of knowledge-value added (KVA) and real options models in identifying, valuing, maintaining, and exercising options in military decision-making. His work on measuring the value of intellectual capital has been featured in a *Fortune* cover story (October 3, 1994) and *Investor's Business Daily*, numerous books, professional periodicals, and academic journals (most recently in the *Journal of Intellectual Capital*, 2005). [tjhousel@nps.edu]

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Abstract

The use of open architecture (OA) systems to guide acquisition of naval systems and the "opening up" of proprietary systems is presumed to have produced significant cost savings. However, their use may have also introduced new forms of risk and uncertainty for the acquisition manager. Addressing this problem, several qualitative research studies were conducted to identify benefits, risks, and best practices from historical case data involving OA, service-oriented architecture (SOA), and modular open systems approach (MOSA) implementations.

Introduction

The use of open architecture (OA) systems to guide the acquisition of naval systems and the "opening up" of proprietary systems is presumed to have produced significant cost savings. However, their use may have also introduced new forms of risk and uncertainty for the acquisition manager. Addressing this problem, several qualitative research studies were conducted to identify benefits, risks, and best practices from historical case data involving OA, service-oriented architecture (SOA), and modular open systems approach (MOSA) implementations.

The first study focused on cost savings from private-sector implementations of SOA in several industries. SOA has proven beneficial in the private sector, which has derived benefits from SOA that include cost savings, agility, and flexibility. Because SOA and OA share comparable concepts, the Department of Defense (DoD) can expect to realize some of the same benefits using OA as the private sector gains from implementing SOA. This study identified potential outcomes and industry best practices for the DoD. Its purpose was to establish a benchmark of performance outcomes, focusing on cost savings experienced in industry to determine what the DoD can expect in its push towards an OA model.

The second study identified OA-based acquisition risks and uncertainties and explored various tools and techniques used by program managers (PMs) in successful acquisition programs. At the onset of this study, it was not clear how risk was defined, perceived, or tolerated at the DoD. Moreover, the issue of risk is a complicated problem. Unlike the private sector, the DoD does not tolerate or reward risk. OA introduces new risk elements to DoD systems development and upgrades; however, the overall acquisitions

approach is essentially designed to suppress risks. It is imperative to understand the risk-suppression steps inhibiting OA's potential ability to reduce costs and increase flexibility. The risk study is augmented by primary research interviews with acquisition professionals.

Specific research objectives for these studies included the following:

- to examine relationships between OA, SOA, and Navy OA (NOA);
- to establish cost-savings benchmarks based on industry performance for traditional proprietary architecture models and SOA;
- to identify the risks to PMs in the Defense Acquisition Systems (DAS) ecosystem, including various organizations involved with acquisitions, ranging from Congress down to a program's risk project team, along with environmental risks, consisting of rules, regulations, laws, and customs dictating organizational behaviors;
- to evaluate whether an OA strategy assists or hinders acquisition programs;
- to ascertain whether an OA strategy exposes a program to unique risks and uncertainties; and
- to establish whether OA has delivered its promised benefits to the DAS.

Open Solutions

The goals of OA are to increase reuse, increase flexibility, shorten delivery time-to-market, reduce costs, leverage competition, and improve interoperability. Of these general goals, decreased delivery time and reduced total ownership costs are the key reasons behind the Navy's interest in OA. Open solutions offer new possibilities for solving business problems, provide business interoperability by standardization and technology transparency, and decrease time to market for key products and services. Some general conclusions about the current state of OA are as follows:

- Organizations are adopting open technology platforms and open-source software for critical business needs, and these technologies are moving into mainstream business practices in corporations such as IBM, Google, Intel, and Pfizer.
- The "open" movement has also changed how society interacts. OA, open source, open access, and open standards have propelled social networking tools like Facebook and Twitter into astronomical growth. Facebook, Twitter, WordPress, and Firefox are all built on flexible platforms that enable co-development and co-creation to varying degrees and invite user opinions.
- SOA and OA are similar concepts, and fulfill the requirements set forth by the DoD for the open systems initiative, as seen in Table 1.

Table 1. Comparison of Open Systems to OA and SOA

Open System Characteristics	Open Architecture Characteristics	Service-Oriented Architecture Characteristics
Heavy emphasis on modularity	Modular design and design disclosure	Modular services
Lower total ownership cost and systems with longer life expectancy	Life cycle affordability	Lifetime costs decreased by reliability and modifiability attributes
Easier, quicker, and less expensive expansion and upgrading	Easily upgradable systems	Easy system upgrades through adaptability, extensibility, and modifiability
High degree of portability, connectivity, interoperability, and scalability	Core concepts of scalability and portability, and stated goal of interoperability	Quality attributes of scalability and interoperability
Faster and less costly technology transfer	Goal to optimize system performance	Quality attribute of performance
	Reusable application software	Reusable services
	Interoperable joint warfighting applications and secure information exchange (common services and information assurance)	Quality attributes of usability (common services) and security

Note. This table was adapted from a similar table in Azani (2001).

Potential Benefits

Quantifying the tangible economic benefits of SOA is not an easy task. Return on investment (ROI) for SOA is oftentimes difficult to calculate because attributes such as efficiency are not easy to quantify. However, calculating ROI is critical, given that most businesses look for tangible ROI when evaluating or approving new or continuing investments. One British study found that 89% of companies use “intuition” or “guesswork” to calculate the ROI of their IT investments (DiMare, 2009, p. 5). According to ZapThink Research (as cited in Schmelzer, 2005), “Only by understanding the full range of SOA value propositions can companies begin to get a handle on calculating the ROI of SOA” (para. 2). Furthermore, Gartner analyst Randy Heffner (as cited in McKendrick, 2007) has said, “Any attempt to assign a specific ROI to SOA should be viewed with heavy skepticism” (para. 3). McKendrick (2007) further argued that SOA is a set of best practices that are relatively intangible. Some argue that not only should monetary values define ROI, but that ROI should be defined by return on closing capability gaps that are targeted by SOA implementation and by nonmonetary valuations, such as customer satisfaction and avoidance of loss of life (Buck, Das, & Hanf, 2008). Figure 1 displays some nonmonetary considerations for analyzing ROI.

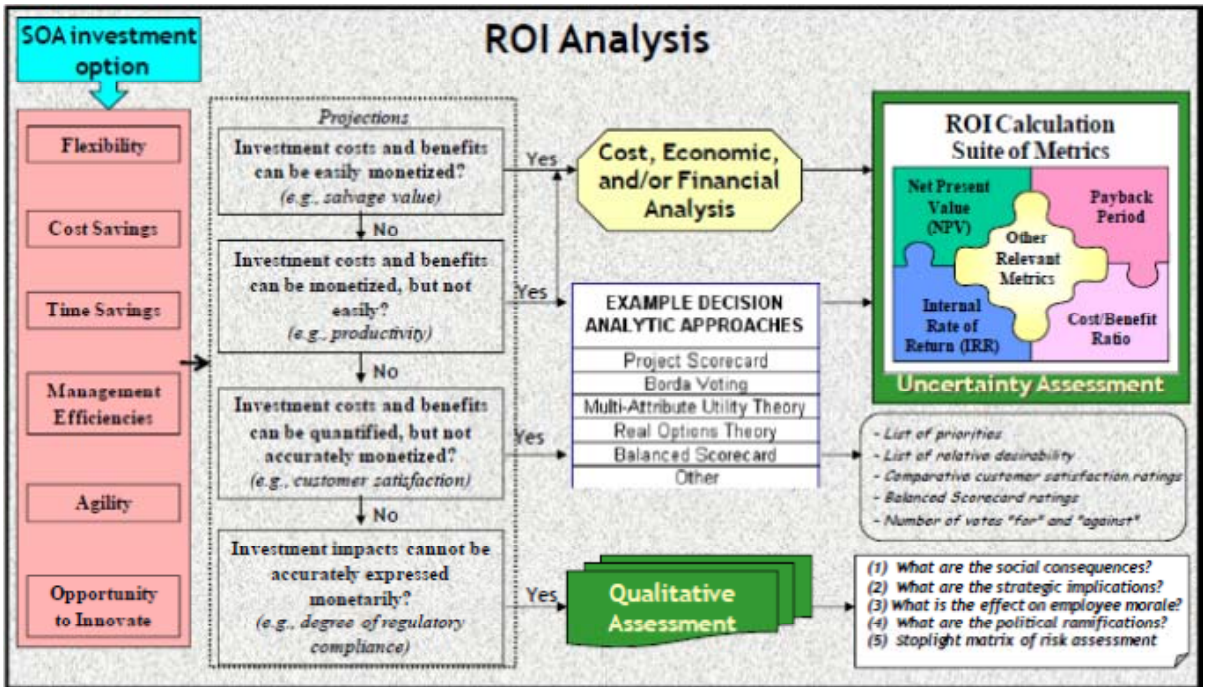

Figure 1. ROI Analysis Considerations for SOA
(Buck et al., 2008, p. 13)

Although it is difficult to quantify, case studies have shown that SOA is beneficial in the private sector, deriving benefits such as cost savings, agility, and flexibility. Similar benefits could be achieved with OA at the DoD. Table 2 displays some of the tangible financial benefits.

Table 2. Baseline Data—ROI Reported by 18 Selected Companies According to Case Study Reports[1]

Company	ROI	Benefit (discounted)	Investment (discounted)	NPV	Discount %	Discount Period (Years)	Payback (months)
Blue Cross Blue Shield of KC	332%	14,330,000	3,320,000	11,010,000	12%	6	20
Mobile Telecom	625%	10,120,000	1,400,000	8,720,000	12%	3	5.6
Real Time Services	215%	180,000	57,000	120,779		5	0
Global Provider for Info Mgmt Sys	470%	8,080,525	1,417,846	6,662,679	12%	3	2.5
Services and Fac Mgmt Co	360%	2,744,982	596,674	2,148,309	12%	3	4.6
European based telecom	212%	5,472,842	1,753,242	3,719,600	12%	3	9
International Finance Firm	252%	$6,627,447	$1,882,568	$4,744,879	12%	3	6.7
Healthcare Provider	356%	$13,475,631	$2,952,633	$10,522,889	12%	6	6.7
Global Media Consulting Firm	244%	$1,541,718	$447,938	$1,093,780	12%	3	8.2
Healthcare Services Provider	346%	$15,800,000	$3,500,000	$12,300,000	12%	3	4.8
Global Financial Services Firm	472%	$37,140,000	$6,490,000	$30,650,000	12%	3	3.9
Carphone	42%	$1,254,000	$812,000			3	30.6
Johnson Controls	81%	$370,000		$143,547		3	12
Bank of India	234%		$23,000,000			5	24
MoreDirect	428%	$445,395	$47,270	$332,251		5	5
International Insurance Provider	256%	$1,428,180	$401,607	$1,026,573	12%	3	8
Global Consumer Products Co	265%	$1,118,547	$306,370	$812,176		3	5.8
Quicken Loans	298%		$183,000				
Average	305%						9.4

Note. This table was constructed using information from the following case studies: Case Study Forum (2009a, 2009b), IDC Business Value Spotlight (2009a, 2009b, 2009c, 2009d, 2009e, 2010a, 2010b, 2010c), IDC ExpertROI® Spotlight (2010a, 2010b, 2010c, 2010d), "Shopping for SOA" (2006), Nucleus Research (2007, 2008), and Thoughtware Worldwide (2010).

Researchers analyzed 34 case studies, 18 of which provided an overall ROI. Ten of these cases were broken down into various cost components. Based on the case studies, conclusions regarding benefits to industry and best practices were developed. As shown in Table 2, the overall ROI from industry SOA implementation was 305%, while the ROI from cost savings and cost avoidance was 72%.

[1] ROI = (Benefit – Cost of Investment)/Cost of Investment

Table 2 displays information from the 18 case studies reporting overall ROI.[2] ROI was calculated over a three- to six-year period. All companies calculated a net present value (NPV) with a discount rate of 12%. Furthermore, a payback period was calculated for most case studies. ROI was calculated with a process of measuring benefits, calculating total investment, and then projecting the investment and benefit over the time period designated.[3]

Although the industry achieved a 72% cost savings, the DoD must weigh other factors before it implements an SOA project. Benefits such as productivity improvements and non-quantifiable benefits should also be considered, along with factors such as flexibility, scalability, and reusability, which all allow for long-term improvement.

Risk and Uncertainty

The goal of project risk management is to increase the probability and impact of positive events and decrease the probability and impact of negative events in the project. This is done through a series of six processes of project risk management: plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk responses, and monitor and control risks (Project Management Institute [PMI], 2008). In practice, different PMs approach each step differently and some may not give equal weight to quantitative risk analysis as opposed to a qualitative approach. These six processes will be valid for most programs, especially in the DoD, as can be seen in Figure 2, which shows the DoD risk management process, along with the six processes of project risk management.

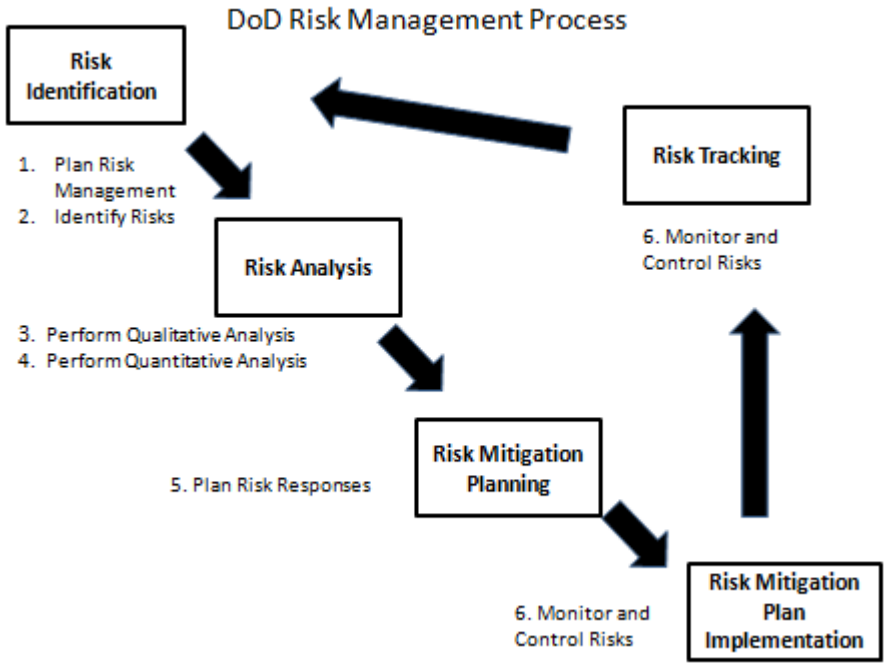

Figure 2. DoD Risk Management Processes With Six Processes of Project Risk Management
(DoD, 2006, p. 45)

[2] Methods for calculating ROI varied because the case studies were conducted by different companies.
[3] The reports did not provide details on exactly how benefits were measured.

- The DoD anticipated that OA principles would enable small, innovative businesses to enter the defense market. The open business model "was envisioned to encourage competition at all system levels, therefore enabling small companies—who cannot compete with the likes of the large contractors for big Navy contracts—to compete their solutions at the sub-system or component level" (Computerworld, 2007).
- Greater competition was expected to provide small-medium sized enterprises (SMEs) opportunities to enter the defense arena and end eras of stove-piped systems and the oligopoly of defense contractors who provide expensive, monolithic systems that do not interoperate.
- SMEs, however, cannot participate in the defense arena because of risk-suppression mechanisms and the exorbitant costs to enter the market. SMEs cannot afford to follow the bureaucratic rules and restrictions that the current acquisition processes in the DoD impose.
- Systematic risk restrictions at the DoD and in the acquisitions process have resulted in programs still going over budgets and schedules, despite attempts to control budget and schedule risk. Until risk issues are addressed, the DoD will never achieve true portfolio management, nor will it ever fully implement OA.
- The *Risk Management Guide for DoD Acquisition* (DoD, 2006) does not prescribe specific methods or tools and only provides general guidance and accepted practices for DoD acquisition professionals to follow.
- DAS does not present PMs with different types of risk at different stages of their careers. Beyond cost, schedule, and performance risks, there is no formal recognition of other risk types. Despite this lack of risk recognition, budget and program risk are of constant concern to PMs.
- Critical risk areas cited in interviews conducted with acquisition professionals were budget uncertainty, program risk and uncertainty, and decreasing returns on increasing assets.
- Not unique to DAS, risks associated with misunderstandings between different functional areas, the "talking by each other" and linguistic discontinuity, are heightened by a lack of training and contradictory structural goals between functional areas of a program, such as between a PM and a contracting officer.
- DAS is highly structured, consisting of well-defined requirements and milestones, so there is little incentive for individual initiative in running projects or programs and little room for personnel flexibility.
- Although the DAS's bureaucratic nature is not a risk, it introduces or amplifies risk as many PMs develop a fatalistic attitude towards risk (i.e., "We have to play with the hand we are dealt."), delaying ramifications for incorrect or even illegal decisions that fall on the program long after the original participants have transferred.
- OA has delivered cost savings and allowed faster system development in certain cases; it has also increased complexity and risk for programs.

NOA Benefits and Lessons Learned

With an open systems approach, the Navy has derived a number of benefits, including decreasing time to field and upgrading in-service systems faster, and modifying or

changing capabilities per fleet at reduced cost. More specifically, OA resulted in benefits to the Acoustic Rapid COTS Insertion (A-RCI) process and the Navy's E-2 program.

Acoustic Rapid COTS Insertion (A-RCI) Process

The submarine fleet saved $4 billion while increasing sensor performance seven-fold (Computerworld, 2007). OA also allows submarines to upgrade software every year and hardware every two years. This approach has been transferred successfully to other submarine systems as well as collaborative efforts of the cross-domain anti-submarine warfare (ASW) community.

A-RCI followed an innovative approach in order to leverage the benefits of collaboration between contractors, both small and large, academic laboratories, and government organizations. Lockheed Martin served as the prime contractor for A-RCI, but the focus was changed to be a "prime system integrator." Even though Lockheed Martin would play the major role in the contract, the door was opened to smaller contractors and other organizations that usually could not or would not participate in the acquisition process. The main vector for input from small contractors and nontraditional entities into A-RCI was the peer review process that selected between different alternatives and chose the best solution, usually after testing with real-world data (Boudreau, 2006).

This strategy arose out of one of the founding guiding principles of the program in that "no single organization [had] the whole story." The peer review process was conducted under the oversight of a Navy PM with the goal of preventing the usual tendency for the prime contractor to mold the program in the most profitable direction for it, possibly ignoring competitor's solutions that may have been more suitable. The peer group structures were designed for flexibility, and an extensive set of working groups were set up to cover most aspects of the program, including a tactical integration advisory group; groups for specific subsystems, such as the APB-1/2 towed array; and, perhaps most important, an operator feedback group. The composition of the groups was fluid over the project life cycle with groups merging or even disbanding depending on the circumstances (Boudreau, 2006). Figure 3 represents the A-RCI process.

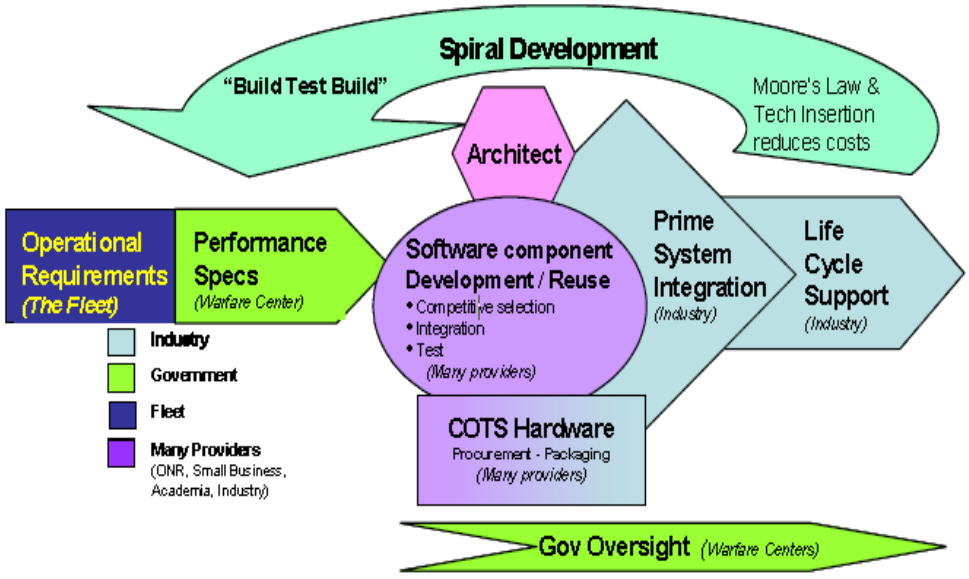

Figure 3. A-RCI System Development Model
(Barron, 2006, p. 54)

Navy's Air Domain

The E-2 program transitioned to a commercial computing plant with a modular software design through OA. Acquisition cycle time was reduced from seven years to 2.5 years, and costs were reduced from over $200 million to under $11 million (Computerworld, 2007).

One of the lessons learned from NOA was overcoming acquisition and defense cultures. According to a 2007 *Computerworld* case analysis, the greatest obstacles cited were the naval acquisition and defense industry cultures. Greatest resistance to NOA came from those who did not understand the OA concept, who did not think it would work, or who were not comfortable with change. The most important obstacles to overcome were cultural issues:

- *"Not Invented Here" Syndrome*. Navy personnel are resistant to being told by outsiders how to conduct their business. Program staff have generally been working within their programs for many years and are confident they know how best to continue conducting their program's business. Past contractors who are now employed by these programs also resist change. This insular environment limits the potential for new ideas and increases resistance to changes introduced from the outside.
- *Complacency*. Large defense industry companies were content with business as usual because they were making huge profits for shareholders. The companies that develop, build, and upgrade the Navy and Marine Corps' National Security Systems (NSS) had no incentive to change their business model while they were so profitable. The predominant industry players needed to be convinced that profits would falter if they did not start producing OA systems.
- *Lack of Asset Sharing*. This stems from the "not-invented-here" syndrome. It is the Naval Enterprise's reluctance to share assets among domains and programs. In addition, this internal attitude is the defense industry's propensity for building new systems from scratch rather than reusing assets that the government already owns and that provide the needed capability (Computerworld, 2007).

Recommendations

Focus on Overall System Value

The overall value offered by an open system should be considered and not only the cost savings. Benefits such as flexibility, scalability, and reusability position the DoD to rapidly adjust systems to changing combat missions and environments while reducing future risk. The DoD should consider reducing the weight given to ROI as a result of cost savings in its decision-making process and attempt to incorporate all associated benefits.

Use an Incremental Implementation Approach

SOA is not a one-size-fits-all solution. The DoD should adopt an incremental approach, implementing OA where results will be immediate. It should assess current DoD architecture to focus efforts on particular needs and requirements. The DoD should start small with near-term or easily implemented requirements, initially attacking the low-hanging fruit by introducing the SOA services that provide the most bang for the buck.

Provide Adequate Resources

Continue building the DoD infrastructure to ensure any new initiatives are sufficiently resourced. SHARE is a warning on lack of resources, particularly the lack of personnel and time, which ensures contractors meet all administrative requirements concerning intellectual property rights. Implementations that do not have supporting infrastructure and proper resources could become costly disasters.

Provide Greater Initiative

DAS has evolved into a system that concentrates on performance issues, even at the expense of costs and schedule. Delivery of world-class systems to operating forces should always remain a priority; however, the DoD should consider allowing PMs more flexibility in running programs. A-RCI showed how taking initial performance risks, security risks that use a COTS strategy, and potential cost and schedule risks that use a spiral development strategy could lead to program success.

Continue Accountability

Many PMs inherit programs that have achieved initial success but at the expense of future risks and stability. If a program is of such a length that a PM has transferred before improprieties or poor decisions are uncovered, then he should remain accountable for decisions in older programs if the PM is still in government service.

Support Greater Flexibility

With a more flexible systems development approach, talent outside DAS could be tapped. Allowing for security concerns, modern problem-solving methods such as Topcoder could be used. The former helps solve technical problems for the pharmaceutical, biotechnology, consumer goods and high technology industries with cash prizes. The latter allows the programming community to compete and collaborate on problems with contests where members compete for money and skill ratings.

Implement New Metrics

Due to the innovativeness of implementing an open business model in DoD acquisitions, new metrics must be implemented. There are many methods available; however, the DoD should consider implementing metrics to measure the new economy based on intellectual capital and knowledge assets.

Conduct a New Study

Conduct a study to determine which DAS areas would benefit from OA and which programs would be hindered by OA and SOA.

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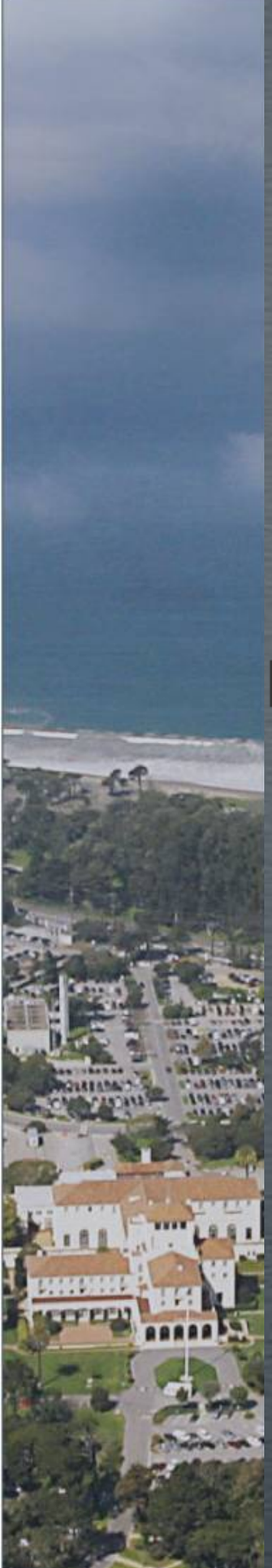


Historical Analysis of Costs, Risks, and Uncertainties: Moving From a Proprietary to an Open Architecture System, Open Business Acquisitions Management Approach

Russ Wolff (USMC) and Scott Cole (Navy)

May 2012

Research Objectives

- examine relationships between OA, SOA, and Navy OA (NOA);
- establish cost-savings benchmarks based on industry performance for traditional proprietary architecture models and SOA;
- identify the risks to PMs in the Defense Acquisition Systems (DAS) ecosystem, including various organizations involved with acquisitions
- evaluate if an OA strategy assists or hinders acquisition programs;
- ascertain if an OA strategy exposes a program to unique risks and uncertainties; and
- establish if OA has delivered its promised benefits to the DAS.

Context: The “Open” Movement

- Defense Acquisitions wants better products for less
  - Open Solutions deliver costs savings and capability improvements to the private sector
  - Open Business systems may deliver these same benefits
  - anticipated that OA principles would enable small, innovative businesses to enter the defense market.
- Service-Oriented Architecture
  - (SOA): “approach for sharing functions and applications across an organization by designing them as discrete, reusable, business-oriented services.” (GAO, 2005)
- Open solutions
  - offer new possibilities for solving business problems, provide business interoperability by standardization and technology transparency, and decrease time to market for key products and services.

Comparison of OA and SOA

Open Architecture Characteristics	Service-Oriented Architecture Characteristics
Modular design and design disclosure	Services are modular
Life-cycle affordability	Reliability and modifiability attributes decrease cost over the lifetime of the system.
Easily upgradable systems	Adaptability, extensibility, and modifiability provide ease of upgrading a system.
Core concepts of scalability and portability, and stated goal of interoperability	Quality attributes of scalability and interoperability
Goal to optimize system performance	Quality attribute of performance
Reusable application software	Reusable services
Interoperable joint warfighting applications and secure information exchange (common services and information assurance)	Quality attributes of usability (common services) and security

Potential Quantitative Benefits

- Case Studies Analyzed the ROI of SOA implementation in 18 different companies- 336% ROI with 72% ROI from Cost Savings

Company	Reported ROI	Calcuated ROI from Cost Savings / Cost Avoidance	Average Annual Cost Savings	Average Annual Cost Avoidance	Average Annual Productivity Improvement	Benefit (discounted)	Investment (discounted)	NPV	Discount %	Discount Period (Years)	Payback (months)
Blue Cross Blue Shield	332%	330%	$2,380,000	$0	$90,000	$14,330,000	$3,320,000	$11,010,000	12%	6	16.7
Mobile Telecom	625%	136%	$1,100,000	$0	$3,570,000	$10,120,000	$1,400,000	$8,720,000	12%	3	15.3
Global Provider for	470%	-18%	$0	$387,853	$2,827,485	$8,080,525	$1,417,846	$6,662,679	12%	3	43.9
Services and Fac Mgmt Co	360%	-100%	$0	$0	$1,140,000	$2,744,982	$596,674	$2,148,309	12%	3	
European based	212%	-18%	$478,463	$0	$1,801,860	$5,472,842	$1,753,242	$3,719,600	12%	3	44.0
International Finance Firm	252%	-31%	$101,015	$329,054	$2,669,439	$6,627,447	$1,882,568	$4,744,879	12%	3	52.5
Global Media Consulting	244%	107%	$111,609	$198,140	$332,626	$1,541,718	$447,938	$1,093,780	12%	3	17.4
International Insurance	256%	7%	$143,839	$0	$427,328	$1,428,180	$401,607	$1,026,573	12%	3	33.5
Healthcare Services	346%	146%	$0	$2,870,000	$3,720,000	$15,800,000	$3,500,000	$12,300,000	12%	3	14.6
Global Consumer	265%	165%	$270,689	$0	$195,366	$1,118,547	$306,370	$812,176	12%	3	13.6
Average	**336%**	**72%**									27.9

Potential Qualitative Benefits as Seen in the Commercial World

Benefit Categories	Examples of Qualitative Measurements	Relationship to the DoD
Business Staff Efficiency	Information delivered to managers more quickly and accurately improves decision-making.	Timely and accurate delivery of information vital to military leaders.
Business Credibility	Equates to more business because other companies view their system as available and reliable.	Productivity improvement through availability and reliability of systems used by the DoD.
Reduced Duplication of Effort	Information entered once, available to all users.	Ensures accuracy and consistency of data. It also saves time inputting data or fixing mismatched data.
Faster Time-to-Market	Difference in the amount of time a product is available compared to the current time to market.	Faster delivery of vital intelligence or logistics when and where required.
Scalability	The ability to increase size or volume without degradation.	Scaling of service in accordance with changing mission.
Flexibility	Flexibility is achieved through increased agility and potential for reuse.	Flexibility allows for quick adaptation to environmental changes.

Small Business Participation

- DoD anticipated greater Small-Business participation through OA
  - Small Business Innovative Research (SBIR) Contracts
- Results showed actual Small Business participation sub-optimal
  - Contract Funds Awarded from 1 February 2012- 31 March 2012

$9,133,000,234	Award Total
$53,409,358	Average Contract Awarded
$537,112,301	Small Business Award Total minus contracts over $100 million
$8,346,994	Average Small Business Contract Awarded minus contracts over $100 million
5.88%	Percentage of Awards given to Small Businesses

Types of Risk

- When interviewed, program managers identified the following types of risk they have to mitigate:

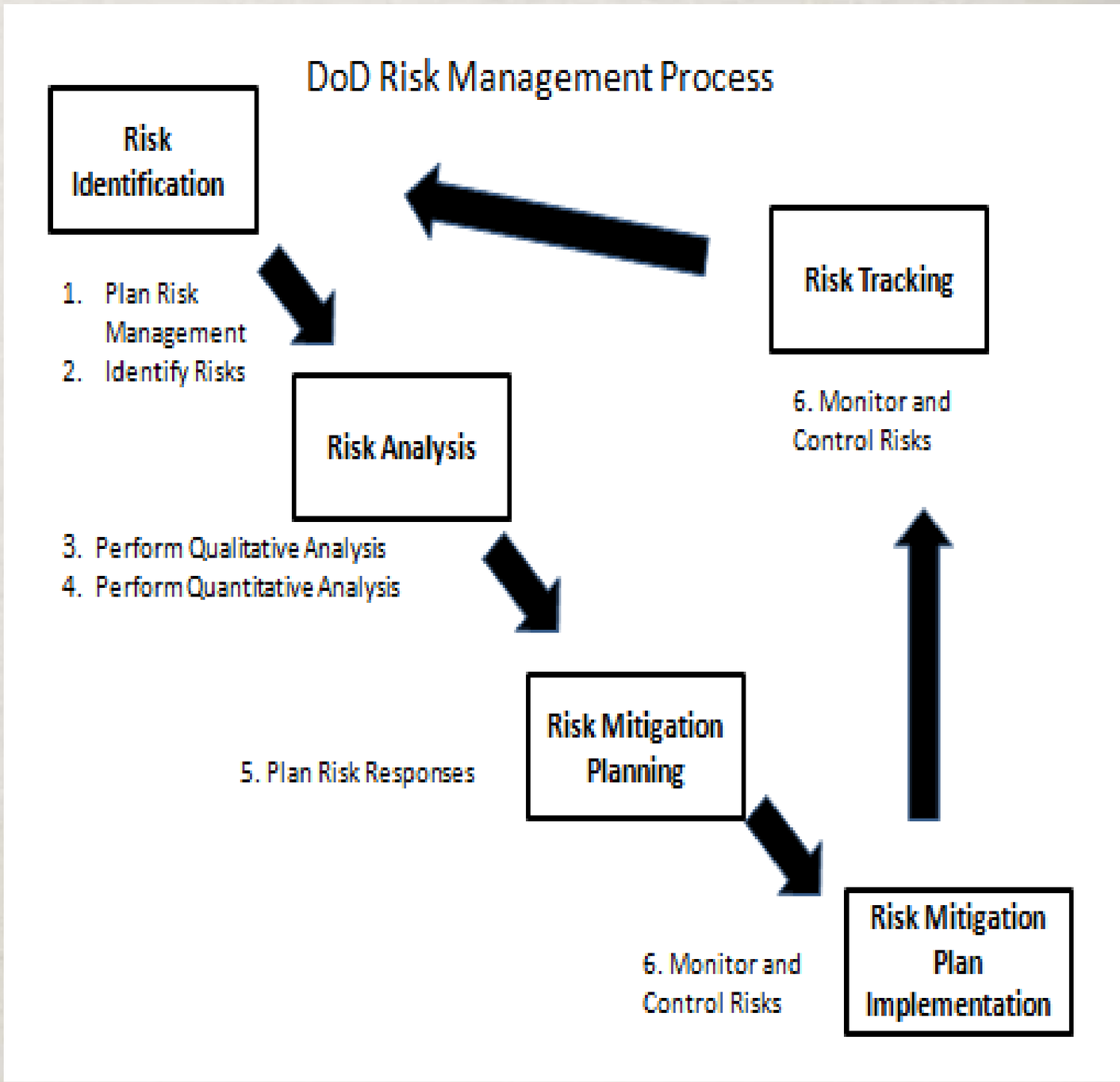
Risk	Number of Times Mentioned	Risk	Number of Times Mentioned	Risk	Number of Times Mentioned
TECHNICAL	10	PERFORMANCE	6	ENVIRONMENT SAFETY & OCCUPATIONAL HEALTH	5
COST	5	SCHEDULE	4	MANUFACTURING	3
OPERATIONAL	2	INTEGRATION	2	ENTERPRISE ARCHITECTURE	2
SYSTEM LEVEL	2	MATERIAL	1	PROGRAM	1

Risk and Uncertainty

- Determined that Risk Suppression excluded Small Companies from participation in an Open Business Model

  - Heavy bureaucracy makes it difficult for small businesses to compete.

  - Because of these risk suppression measures, entry costs prohibit entry of small businesses into the acquisitions environment.



Top Internal Barriers to OA

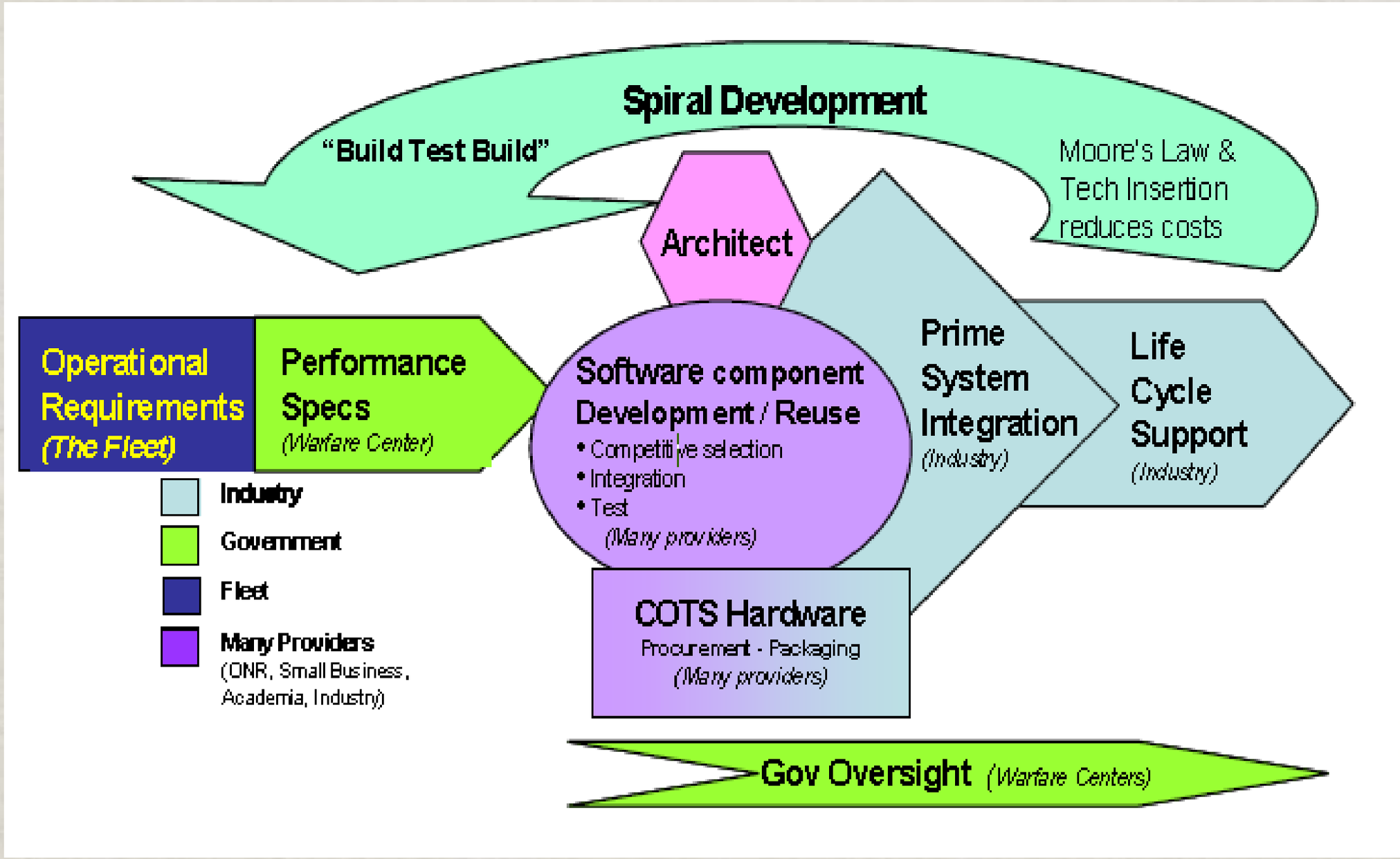
- **Current flow of money - Budget allocations through organization**
- **Lack of defined reference architecture**
- **Lack of OA understanding**
- **Lack of resources**
- **Unwillingness to break existing contracts**
- **Lack of OA education and training**
- **Lack of formal requirements**
- **Perceived up-front investment too expensive**
- **Lack of incentives**
- **Lack of contractual requirements**
- **T&E and Certification issues**
- **Fear of Change – ranked #1 by respondents w/A-RCI experience**
- **Lack of centralized configuration management control**
- **Lack of leadership support**
- **Current Organizational Structure**
- **Lack of accountability**

A-RCI Success Story

- Demonstrated practical application of Open Systems methodology by successfully implementing an improved sonar system while beating budget and time goals:
  - Life cycle costs were improved by a factor of close to 5
  - a seven-fold increase in processing capability
  - mean operator success rate increased by a factor of four
  - mean number of false alarms reduced by 40%
  - detection and classification time improved by 27 minutes

5/18/2012

A-RCI Development Model



A-RCI Best Practices and Risks

Best Practices and Successful Strategies	Introduced Risks
A-RCI	
COTS	Security Risk Program Risk (bureaucratic friction)
Incremental Strategy	Operational Risk (initial deployed system does not meet user requirements) Cost Risk Schedule Risk
MOSA	Integration Risk
Open Capabilities-Based Model	Integration Risk Program Risk (bureaucratic friction)

Conclusions

- DoD must address risk management to implement OA/SOA
  - Regardless of risk suppression measures, current programs still miss time and budget requirements
  - DoD should examine the commercial world risk construct that includes the upside as well as downside of risk
  - Until the total risk constructs is addressed, the DoD will never achieve true portfolio management nor will it ever fully realize the potential of OA.
- DoD must weigh other factors in addition to cost-savings when considering Open Systems approaches
  - Productivity Improvements- measured by meaningful, valid ROI projections that need to be established
  - Flexibility, Scalability, and Reusability- measured by Real Options Analysis

Recommendations

- **Implement New Metrics**
  - Traditional ROI insufficient for the DoD's needs: Current ROI estimates rely on cost-savings or avoidance data that does not provide a unique numerator.
  - Portfolio optimization and real options for forecasting future
- **Incremental Implementation Approach**
  - Attack the low-hanging fruit by introducing SOA services that provide the most bang for the buck.
- **Provide Greater Initiative for PMs**
  - A-RCI showed how taking initial performance risks, security risks using a COTS strategy, and potential cost and schedule risks using a spiral development strategy could lead to program success